shown that these results require some not inconsiderable alterations, it would appear that some further modifications of Powalky's corrections must also be required. I have, however, given one other test of the accuracy of the Right Ascensions of the 1860 Catalogue. I find in the same zone eighty-four stars which are also contained in the 1840 Catalogue. I have, therefore, brought up the Right Ascensions of the 1860 Catalogue to 1880, with the proper motions found for the 1840 and 1880 Catalogues. The mean difference thus found is only $+0^{s}\cdot03$.

Such quantities as these are certainly not larger than those which will be found to result from similar comparisons between the best existing catalogues if separated by intervals of twenty years.

On the Diameters of the Sun and Moon as observed with the Greenwich Transit Circle. By W. G. Thackeray.

(*Communicated by A. M. W. Downing.*)

In one of the numerous sections of "Greenwich Observations" are yearly given the results of the comparisons of the diameters of the Sun and Moon, as computed by the *Nautical Almanac* Office, and as observed with the Greenwich Transit Circle, in the form of error of the *Nautical Almanac* diameter, and the mean of all these errors for the year, with the number of observations on which the value depends, is given in the several introductions.

A discussion of these errors, for several years previous to 1864, led to the adoption of a correction of $-0''\cdot53$ to the computed value of the *Nautical Almanac* semi-diameter of the Sun in all cases whenever a single limb only was observed, and this correction, which has continued to accord with the mean annual error year by year, has been still applied up to the present time whenever necessary. While casually looking into the observations on which this correction has been founded, I was drawn into an inquiry as to what is the mean value of the diameter of the Sun and Moon, given by all the observations made with the Greenwich Transit Circle, and what is the special value given by each of the regular observers? In other words, what is the amount of personality hidden away under this uniform annual mean?

The following Tables I. and II. are formed by extracting directly from the several volumes of "Greenwich Observations" the mean annual errors of the *Nautical Almanac* horizontal and vertical diameters of the Sun and Moon, with the number of observations on which they depend, so that the resulting value of the diameter is one which depends on a long series of observations made by various observers, and spread over a number of years.

Tables III. and IV. are formed by taking from one of the planetary sections the daily errors of the *Nautical Almanac*

vertical diameters of the Sun and Moon, as given by each of the regular observers for a period of years, and ranging them under each observer's name, and the tabular figures represent the mean annual error with the number of observations on which the value depends subscribed.

The number of observations of the double limbs of the horizontal diameter of the Moon with the Transit Circle are, unfortunately, not sufficiently numerous to afford any reliable information; but, in the case of the horizontal diameter of the Sun, Mr. Dunkin has already printed in the *Monthly Notices* several papers which exhibit the amount of personality to be expected.

TABLE I.

Apparent Errors of the Duration of Passage of the Sun's Horizontal Diameter, and of the Sun's Vertical Diameter as computed in the "Nautical Almanac."

Year.	No. of Obs. of Horizontal Diameter.	Mean Value of N.A.−Obs. s	No. of Obs. of Vertical Diameter.	Mean Value of N.A.−Obs. ″
1861	108	+0·10	113	+0·97
1862	81	+0·13	87	+1·11
1863	103	+0·12	107	+1·29
1864	105	+0·08	111	+1·09
1865	104	+0·07	117	+1·02
1866	95	+0·08	103	+1·11
1867	73	+0·11	83	+1·39
1868	111	+0·08	126	+1·33
1869	79	+0·12	93	+1·60
1870	106	+0·12	119	+1·29
1871	103	+0·11	104	+0·65
1872	107	+0·12	109	+0·64
1873	102	+0·11	108	+0·49
1874	94	+0·10	95	+0·17
1875	96	+0·11	104	+0·59
1876	99	+0·11	96	+1·03
1877	75	+0·10	75	+1·02
1878	77	+0·10	72	+1·34
1879	61	+0·09	64	+1·33
1880	99	+0·08	104	+1·38
1881	107	+0·09	108	+0·93
1882	87	+0·08	97	+0·68
1883	113	+0·05	122	+0·87

Weighting these results according to the number of observations in each year, and remarking that in the case of the duration of the passage of the horizontal diameter we shall not be much in

error in multiplying by 14 to convert into seconds of arc, we obtain

Period.	No. of Obs. of Horizontal Diameter.	Mean Value of N.A.−Obs.	No. of Obs. of Vertical Diameter.	Mean Value of N.A.−Obs.
		s		″
1861–83	2185	+0·097	2317	+1·00
		or +1″·36		

Remarking that the assumed value of the *Nautical Almanac* diameter of the Sun at the Earth's mean distance has been 32′ 3″·64 since 1853, and changing the sign of the errors to obtain the corrections, we get

Period.	No. of Obs.	Corrected Hor. Diam.	No. of Obs.	Corrected Vert. Diam.
1861–83	2185	32′ 2″·28	2317	32′ 2″·62

In vol. 22 of the *Monthly Notices*, in a paper entitled 'On the Circularity of the Sun,' Sir G. B. Airy obtained the following results from the diameter:—

Period.	No. of Obs. Hor. Diam.	Corrected Hor. Diam.	No. of Obs. Vert. Diam.	Corrected Vert. Diam.
1853–60	795	32′ 2″·65	851	32′ 2″·61

Combining the two results together, and weighting them according to the number of observations, we finally obtain

1853–80	2980	32′ 2″·38	3168	32′ 2″·62

It seems curious that the values of the vertical diameter for the two periods 1853-60 and 1861-83 should be nearly identical, while those of the horizontal diameter should differ by 0″·37; but this difference may with great probability be ascribed to a change in the observing staff, and the consequent change in the mean value of the personality of all the observers. As it may be instructive to trace the changes made in the staff of the Observatory, we therefore record, as shortly as possible, the history bearing on this point.

In 1853, the Rev. R. Main was chief assistant, and the other assistants were Messrs. Henry, Dunkin, Breen, Ellis, and Todd. Mr. Breen superintended the computers and virtually did no observing.

In 1854, Mr. Todd resigned, and was succeeded by Mr. Criswick.

In 1857, Mr. Henry died, and was replaced by Mr. Lynn.

In 1859, Mr. Breen resigned, and Mr. Lynn superintended computers and virtually did no observing, and Mr. James Carpenter was appointed an assistant.

In 1860, Mr. Main resigned, and Mr. Stone was appointed in his place, and no change took place in the staff till,

In 1870, Mr. Stone resigned, and Mr. Christie took his place. Mr. Dunkin was made superintendent of computers and did no observing, and Mr. Lynn became an observing assistant.

In 1873, Mr. Downing was appointed in the place of Mr. James Carpenter, who resigned, and Mr. Maunder was appointed physical assistant.

In 1875, Mr. Thackeray succeeded Mr. Glaisher, who resigned, and Mr. Ellis was transferred to superintend the Magnetical and Meteorological Observatory.

From 1877 till 1880, Mr. Lynn was ill and did little or no observing, so that a great many more computers than usual were employed in making observations.

In 1881, Mr. Lewis succeeded Mr. Lynn, who resigned in 1880.

In 1882, the vacancy caused by the appointments of Mr. Christie and Mr. Dunkin to be respectively Astronomer Royal and Chief Assistant, was filled up by Mr. Hollis, and Mr. Criswick was made superintendent of computers, and ceased to be an observing assistant. Since that time the staff has remained the same.

We may fairly assume therefore that the mean value of the two diameters, viz., $32'\ 2''{\cdot}5$, would very accurately represent the diameter of the Sun as seen in the Greenwich Transit Circle by a being whom we will designate for want of a better name, a "mean observer."

TABLE II.

Apparent Errors of the Duration of Passage of the Moon's Horizontal and Vertical Diameter as computed in the "Nautical Almanac."

Year.	No. of Obs. Hor. Diam.	Mean Value of N.A.—Obs.	No. of Obs. Vert. Diam.	Mean Value of N.A.—Obs.	Mean N.A. Diameter.
		s		"	′ "
1856	3	−0·05	13	−2·02	31 9·22
1857	3	+0·13	11	+1·03	31 9·36
1858	5	+0·07	15	+0·92	... ...
1859	4	+0·14	16	+2·39	... ...
1860	1	+0·05	9	+2·11	... ...
1861	2	+0·11	10	+0·93	... ...
1862	2	+0·08	1	+0·25	31 8·20
1863	3	+0·02	7	−1·43	... ...
1864	2	+0·06	5	−0·49	... ...
1865	4	+0·08	7	+0·03	... ...
1866	2	+0·09	7	+0·81	... ...
1867	3	+0·17	2	−0·09	... ...
1868	4	−0·03	13	+0·90	... ...
1869	2	−0·03	4	+1·31	... ...
1870			5	−0·36	... ...
1871	2	+0·04	7	+0·72	... ...
1872	2	−0·03	5	−1·34	... ...
1873	2	+0·08	8	+0·27	... ...
1874	2	−0·03	12	−1·41	... ...

Year.	No. of Obs. Hor. Diam.	Mean Value of N.A.—Obs.	No. of Obs. Vert. Diam.	Mean Value of N.A.—Obs.	Mean N.A. Diameter.
		s		"	′ ″
1875	2	+0·17	8	+0·49	... ...
1876	4	+0·17	3	−3·62	... ...
1877	2	+0·05	9	−0·99	... ...
1878	1	−0·20	6	+0·83	... ...
1879	1	+0·12	8	−0·16	... ...
1880	2	+0·01	14	−0·29	... ...
1881	2	+0·06	14	−0·45	... ...
1882	4	−0·03	21	−0·19	... ...
1883			11	−0·84	... ...

Grouping these figures according to the different values of diameter, we obtain

Period.	No. of Obs. Hor. Diam.	Mean Value of N.A.—Obs.	No. of Obs. Vert. Diam.	Mean Value of N.A.—Obs.	Mean N.A. Diameter.
				"	′ ″
1856	3	−0ˢ·050 or −0″·70	13	−2·02	31 9·22
1857–61	15	+0ˢ·105 or +1″·47	61	+1·38	31 9·36
1862–83	48	+0ˢ·049 or +0″·69	187	−0·25	31 8·20

Since 1862, Hansen's Tables have been used in the *Nautical Almanac*, and taking the value of the Moon's semi-diameter as given by Hansen =num. (log = 4.750519) × sin(parallax equatorial and horizontal), and assuming the value of the mean equatorial horizontal parallax to be that given by Adams, viz., 57′ 2″·3, we find the corresponding value of the diameter to be 31′ 8″·20. Therefore, using this value, we obtain

Period.	No. of Obs. Hor. Diam.	Corrected Hor. Diam.	No. of Obs. Vert. Diam.	Corrected Vert. Diam.
		′ ″		′ ″
1856	3	31 9·92	13	31 11·24
1857–61	15	31 7·89	61	31 7·98
1862–83	48	31 7·51	187	31 8·45

Combining these results together, we finally obtain

		′ ″		′ ″
1856–83	66	31 7·71	261	31 8·48

Considering the number of observations and the difficulties under which these observations are frequently made, one of the limbs being generally more or less rugged and defective in illumination, the agreement is as near as can be expected, and tends to prove that the value of the diameter as used in the *Nautical Almanac* is very satisfactory.

TABLE III.

Mean Annual Value of the Error of the Vertical Diameter of the Sun as computed in the "Nautical Almanac."

Year.	Dunkin.	Ellis.	J. Carpenter.	Criswick.	Lynn.	Downing.	Thackeray.	Lewis.	Hollis.
	″	″	″	″	″	″	″	″	″
1861	$+2{\cdot}33_{14}$	$-0{\cdot}14_{18}$	$+1{\cdot}93_{9}$	$+0{\cdot}92_{19}$					
1862	$+1{\cdot}62_{7}$	$-0{\cdot}18_{15}$	$+2{\cdot}55_{14}$	$+1{\cdot}19_{15}$					
1863	$+2{\cdot}23_{16}$	$+0{\cdot}24_{26}$	$+3{\cdot}21_{21}$	$+1{\cdot}02_{19}$					
1864	$+2{\cdot}37_{17}$	$-0{\cdot}67_{21}$	$+3{\cdot}31_{19}$	$+1{\cdot}19_{27}$					
1865	$+2{\cdot}32_{18}$	$-0{\cdot}63_{26}$	$+2{\cdot}71_{19}$	$+1{\cdot}68_{28}$					
1866	$+2{\cdot}34_{18}$	$-0{\cdot}22_{19}$	$+2{\cdot}48_{19}$	$+1{\cdot}31_{16}$					
1867	$+2{\cdot}16_{15}$	$-0{\cdot}17_{19}$	$+2{\cdot}57_{14}$	$+2{\cdot}35_{14}$					
1868	$+2{\cdot}28_{19}$	$-0{\cdot}49_{20}$	$+2{\cdot}78_{14}$	$+1{\cdot}59_{22}$					
1869	$+2{\cdot}50_{14}$	$-0{\cdot}21_{18}$	$+4{\cdot}68_{13}$	$+1{\cdot}73_{17}$					
1870		$-0{\cdot}83_{19}$	$+3{\cdot}97_{22}$	$+1{\cdot}46_{20}$	$-0{\cdot}96_{19}$				
1871		$+0{\cdot}17_{15}$	$+3{\cdot}99_{13}$	$+1{\cdot}74_{17}$	$-1{\cdot}99_{28}$				
1872		$+0{\cdot}49_{22}$	$+2{\cdot}96_{14}$	$+1{\cdot}93_{17}$	$-1{\cdot}75_{23}$				
1873		$+0{\cdot}61_{18}$		$+1{\cdot}13_{15}$	$-1{\cdot}26_{20}$	$+0{\cdot}22_{27}$			
1874		$-0{\cdot}16_{13}$		$+1{\cdot}99_{15}$	$-1{\cdot}79_{20}$	$+0{\cdot}46_{4}$			

Year.	Dunkin.	Ellis.	J. Carpenter.	Criswick.	Lynn.	Downing.	Thackeray.	Lewis.	Hollis.
	"	"	"	"	"	"	"	"	"
1875				$+2.55_{15}$	-1.14_{10}	$+1.13_{14}$	$+1.41_{12}$		
1876				$+2.33_{14}$	-1.23_{9}	$+1.79_{19}$	$+0.45_{18}$		
1877				$+2.86_{10}$		$+2.46_{11}$	-0.59_{12}		
1878				$+1.86_{10}$		$+2.72_{16}$	-0.08_{9}		
1879				$+2.06_{11}$		$+2.11_{14}$	$+2.09_{9}$		
1880				$+1.50_{15}$		$+2.26_{25}$	$+1.37_{19}$		
1881				$+1.96_{15}$		$+2.31_{22}$	$+1.42_{17}$	-0.26_{23}	
1882						$+1.47_{14}$	$+0.89_{21}$	$+0.81_{18}$	-0.18_{25}
1883						$+2.45_{21}$	$+1.51_{24}$	$+1.01_{21}$	$+0.59_{19}$
Means	$+2.28_{138}$	-0.19_{269}	$+3.13_{191}$	$+1.65_{117}$	-1.59_{119}	$+1.70_{203}$	$+1.01_{141}$	$+0.48_{62}$	$+0.15_{44}$
Probable error of Means	±0.068	±0.065	±0.063	±0.041	±0.087	±0.055	±0.068	±0.1143	±0.1441
Probable error of a single obs.	±0.799	±1.066	±0.871	±0.764	±1.062	±0.784	±0.807	±0.900	±0.934

Mean of all observers ... ... $+1''.11_{1544} \pm 0.0221$

From these figures it seems clear that the value of the diameter, as depending on the several observers, varies very considerably, the difference in the case of Mr. Lynn and Mr. Carpenter amounting to nearly 5″. The − sign denotes that the micrometer wire is placed by the observer outside, and the + sign, that it is placed within the limbs, as represented by the *Nautical Almanac* diameter. The error, as given by the same observer, varies somewhat from year to year, so that the system adopted at the Washington Observatory in cases of the observation of a single limb, of correcting the diameter from the mean error of all the observations made during the year by the same observer, is preferable to a uniform correction from the mean of all the observers, for in some cases such a correction only aggravates the error it was meant to remedy.

In vol. xxxv., p. 91, of the *Monthly Notices*, Mr. Dunkin has represented the tabular error of the duration of the horizontal diameter of the Sun for the ten years 1864-73 to be as follows:—

Period.	Dunkin.	Ellis.	Criswick.	Lynn.	J. Carpenter.
	s	s	s	s	s
	+ 0·062	+ 0·106	+ 0·022	+ 0·075	+ 0·175
1864-73	or	or	or	or	or
	″	″	″	″	″
	+ 0·87	+ 1·48	+ 0·31	+ 1·05	+ 2·45

Comparing these values with those obtained for the vertical diameter, there appears to be a smaller amount of personality, the greatest difference amounting to a little more than 2″. Mr. Carpenter develops the same strong individuality, and Mr. Lynn reverses the sign of his error, so that his vertical and horizontal diameters differ in value by as much as 2″·64. Assuming that the number of observations made by each of these observers for this period is much the same, the mean error from all the observers would be + 1″·23, and taking the mean of the same five observers for observations of the vertical diameter, the mean error is + 1″·13, a result which is practically identical with the first.

Table IV.

Apparent Errors of the Vertical Diameter of the Moon as computed by the "Nautical Almanac.

Year.	Dunkin.	Ellis.	Criswick.	J. Carpenter.	Lynn.	Downing.	Thackeray.	Lew
	"	"	"	"	"	"	"	
1862		$+0.25_1$						
1863	-0.95_2		$+1.03_2$	$+0.48_1$	-3.25_1			
1864		-1.61_1	$+3.06_1$	$+0.48_1$				
1865	-0.72_2		$+1.27_2$	$+1.32_1$				
1866	$+0.88_1$	-0.49_3	$+1.11_1$	$+2.56_2$				
1867		-1.11_1	$+0.93_1$					
1868	$+0.32_2$	-1.46_1	$+1.23_4$	$+1.51_5$				
1869			$+1.28_4$					
1870			-2.37_1	$+1.60_1$	-3.64_2			
1871		$+0.39_2$	$+1.36_2$					
1872		-1.24_1	$+0.09_2$		-3.32_2			
1873		$+1.62_1$	-2.01_2		-6.10_1	$+2.02$		

Year.	Dunkin.	Ellis.	Criswick.	J. Carpenter.	Lynn.	Downing.	Thackeray.	Lewis.	Hollis.
	″	″	″		″	″	″	″	″
1874		-0.17_6	-1.49_2			-2.28_3			
1875			-1.80_1		-4.48_1	-0.08_3	$+2.24_1$		
1876							-3.90_2		
1877			-0.33_1		-1.13_2	-0.31_1	-2.54_2		
1878			$+3.08_2$			-3.27_1	$+1.61_1$		
1879			-0.23_6				$+0.74_1$		
1880			-0.18_4			$+0.05_5$	-0.83_3		
1881			$+0.79_4$			-1.69_3	-0.05_3	-1.92_2	
1882						-0.98_5	$+0.89_5$	-1.68_3	-0.83_3
1883						$+0.41_2$	$+0.36_2$	-2.69_3	$+0.09_2$
Means	-0.27_7	-0.31_{17}	$+0.46_{42}$	$+1.59_{11}$	-3.34_9	-0.72_{24}	-0.29_{20}	-2.12_8	-0.47_5
Probable error of Means	±0.3817	±0.2768	±0.1526	±0.2206	±0.3968	±0.2454	±0.2535	±0.3167	±0.5998
Probable error of a single obs.	±1.010	±1.141	±0.977	±0.732	±1.191	±1.202	±1.131	±0.895	±1.341

Mean of all the observers ... ... $-0''.31_{143} \pm 0''.0872$.

In forming these tables, three observations in which the errors exceed 6″ were rejected, one by Mr. Dunkin in 1863 (−7″·39), and two by Mr. Downing in 1873 and 1874 respectively (+7″·27) and (−6″·15).

The resulting errors again point to large personalities in the measurement of the diameter of the Moon as in the case of the Sun, and Mr. Lynn and Mr. Carpenter again differ in their values by nearly 5″.

Though these results are not entitled to the same value as those of the Sun, on account of the much fewer number of observations, yet taken in connection with those of the Sun, they indicate a very definite and systematic error, as peculiar to an observer as a rate is to a chronometer, and one from which there seems to be no method of escape.

While this personality does not affect the tabular place of the Sun, as the process of taking the mean of the limbs eradicates the mischief, in the course of a lunation the quantities involved seem to be of sufficient magnitude to seriously affect the value of the tabular errors derived from the observations of the Moon.

A Note of an Observation during the Transit of Jupiter's Satellite IV., April 18. By Edmund J. Spitta.

The greater portion of this transit was observed here, both with the 10-inch reflector and three-inch Tulley refractor. Definition fair; temperature 54 F.; barometer 30·14.

The satellite for the greater part of the transit appeared black, as it commonly does; but what I should like to call attention to is, that this blackness remained until egress, *instead of disappearing about ten minutes before*—an observation I believe unique, and seen also by Mr. Gledhill of Bermerside, as well as others.

Further than this nothing unusual occurred, excepting that for about half an hour, between 11 and 11.30, the satellite became exceedingly faint, appearing to me, at times of good definition, irregularly elongated parallel to the belts, assuming then more of a chocolate colour. (Mr. Gledhill also noticed the faintness and ill-defined appearance at the same hour.) I was also struck by the faint appearance both before and after transit of this satellite as compared with the others; and, to use an expression once employed by Dawes, "it was far from obvious."

I may add that Satellite III., during a dark transit on May 2 (temperature 46° F., barometer 29·58, definition good until the time of egress, when it became unsteady) was quite different. While dark, it appeared uniformly round, and of a deep steel colour, and about ten minutes before egress became invisible, but eventually reappeared on the limb of the planet, perfectly white and defined, during good moments of definition.

Ivy House, Clapham Common:
1885, *May* 4.
